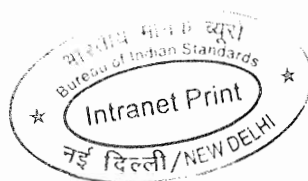


भारतीय मानक
धात्विक सर्पिल कुंडलित गास्केट — विशिष्टि
(पहला पुनरीक्षण)

Indian Standard
METALLIC SPIRAL WOUND
GASKETS — SPECIFICATION
(*First Revision*)

ICS 23.040.80



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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

September 2013

Price Group 4

MAX. RETAIL PRICE
INCL. ALL TAXES
₹210.00

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Gasket and Packing Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard was first published in 1975. The experience gained in implementation of the standard and revision/superseding of reference standards have necessitated this revision.

Sizes and pressure ratings covered in this standard are in line with other International Standards.

A number of standards have already been formulated on flanges at national level which are useful while referring this standard. Some of these standards are given below:

<i>IS No.</i>	<i>Title</i>
3516 : 1966	Cast iron pipe flanges and flanged fittings for petroleum industry
4864 : 1968	Shell flanges for vessels and equipment: General requirements
4865 : 1968	Welded shell flanges for non-pressure service
4866 : 1968	Welded shell flanges for carbon steel pressure vessels and equipment
4867 : 1968	Welded neck shell flanges for carbon steel pressure vessels and equipment
4868 : 1968	Welded shell flanges for stainless steel pressure vessels and equipment
4869 : 1968	Welded shell flanges with hub for stainless steel pressure vessels and equipment
4870 : 1968	Flat gaskets for shell flanges
6392 : 1971	Steel pipe flanges
6418 : 1971	Cast iron and malleable cast iron flanges for general engineering purposes
8288 : 1976	Specification for bakeable flanges
10738 (Part 1) : 1983	Specification for flanges for waveguides: Part 1 General requirements and tests
13159 (Part 1) : 1993	Pipe flanges and flanged fittings — Specification: Part 1 Dimensions

The Committee responsible for the formulation of this standard is given at Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the results of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

METALLIC SPIRAL WOUND GASKETS — SPECIFICATION

(First Revision)

1 SCOPE

This standard specifies the material, dimensions and tolerances, compression and recovery and general requirements for metallic spiral wound gaskets with outer rings and inner rings for use in steel flanges with flat face and raised faces.

Spiral wound gaskets are identified by flange nominal bore and its pressure rating. Sizes and pressure rating covered in this standard are:

- a) *Nominal Pipe Bore* — 15 to 1 500 mm; and
- b) *Pressure Rating* — 1.0 MPa (10 kgf/cm²) to 17.5 MPa (175 kgf/cm²).

2 REFERENCE

The following standard contains provision which through reference in this text constitutes provision of this standard. At the time of publication the edition indicated was valid. All standards are subject to revision and parties to agreements based on this standard is encouraged to investigate the possibility of applying the most recent edition of the standard indicated below.

<i>IS No.</i>	<i>Title</i>
6911 : 1992	Stainless steel plate, sheets and strip — Specification

3 TYPES

Metal gaskets shall be of the following two types:

- a) *Type 1* — The sealing element fitted with outer ring, and

- b) *Type 2* — The sealing element fitted with inner and outer ring.

NOTES

- 1 The user shall have to specify inner ring of all sizes and pressure rating for the stability of the gasket and its safe operation.
- 2 The selection of the winding metal and filler material shall take into account the fluid handled, operating and service conditions, flange surface finish and the flange bolt loading.

4 MATERIALS

4.1 The metal winding of the gasket shall be made of materials given in Table 1 according to the temperature requirements of the flange joint, unless otherwise specified by the purchaser.

4.2 The outer ring shall be made of annealed carbon steel having a minimum tensile strength of 420 MPa unless otherwise specified by the purchaser. This shall be suitably plated to prevent rusting. Unless otherwise specified by the user, inner ring shall be the same metal as of the winding metal.

4.3 Filler material shall be as given in Table 2. Asbestos, or other suitable soft material as specified by the purchaser may be used.

5 CONSTRUCTION

5.1 The spiral wound gasket shall be made of a continuous strip of preformed metal, wound spirally from inside to outside with filler material between each ply. After completion of the winding, the filler material shall be flush or slightly protruding and in no case below the metal winding at the gasket contact surfaces.

Table 1 Metal Winding Material
(Clause 4.1)

SI No. (1)	Ref to Indian Standard (2)	Grade/Numerical Symbol (3)	Temperature of Fluid (4)	Colour Code (5)
i)	IS 6911	X04Cr19Ni9/304	From 260°C to 455°C	Red
ii)	IS 6911	X04Cr17Ni12Mo02/316 X04Cr18Ni10Nb/347	From 455°C to 732°C	Blue
iii)	—	Nickel alloy of chemical composition [79.5 percent Ni, 18 percent Cr, 0.05 percent C (Max)]	From 732°C to 1 030°C	White

Table 2 Non-Metallic Filler Materials, Colour Coding and Abbreviations
(Clause 4.3)

Sl No. (1)	Non-Metallic Filler Materials (2)	Material Abbreviation (3)	Colour Code (4)
i)	Chrysotile asbestos	ASB	No stripe
ii)	Polytetrafluoroethylene	PTFE	White stripe
iii)	Mica-graphite	MG	Pink stripe
iv)	Flexible-graphite	FG	Gray stripe
v)	Ceramic	CER	Light green stripe

5.2 At least three initial turns and three final turns of the spiral metal strip shall be wound without the filler material and shall be firmly secured by welding. The initial 2 plies shall be spot welded for full round circumferentially with minimum of 3 spot welds and spaced with a maximum gap distance of 80 mm. The outer metal windings without filler shall be spot welded for full round circumferentially with minimum of 3 spot welds and spaced with a maximum gap distance of 80 mm and the terminal welds with 40 mm gap. Up to four additional loose preformed metal winding beyond the terminal welding are allowed to fit the sealing element in to the outer ring.

5.3 The shape of the preformed metal strip shall be in V form, unless otherwise configuration specified by the purchaser. The number of plies, pitch of the spiral and thickness of filler material are not specified in this standard; it shall be as agreed to between the manufacturer and the purchaser according to the pressure ratings.

5.4 Gasket for use with raised or, flat face flange joints shall have a centering ring around the sealing element. The sealing element shall fit in to this centering ring which should not come out during normal handling.

5.5 Requirements of Inner Ring

5.5.1 Spiral wound gasket having filler material PTFE of size 600 mm and above shall be fitted with inner ring. Gaskets of the following size and pressure rating shall also be fitted with inner ring.

Nominal Pipe Size	Pressure Rating
100 mm and above	25.0 MPa (250 kgf/cm ²)
300 mm and above	10.0 MPa (100 kgf/cm ²)
600 mm and above	6.0 MPa (60 kgf/cm ²)
650 mm to 1 500 mm	All

5.5.2 It is recommended that requirement of inner ring shall be specified by the user for spiral wound gasket having any filler material.

6 DIMENSIONS AND TOLERANCES

6.1 The gasket dimensions shall be in accordance with Tables 3 and 4 read with Fig. 1 unless otherwise specified by the purchaser.

6.1.1 The thickness of the winding metal, filler material, outer ring, inner ring, sealing element shall be as given below when measured across the metallic portion of the gaskets excluding the filler, which may protrude slightly.

6.1.2 Thickness of Various Gasket Parts

Winding metal thickness	: 0.152 to 2.28 mm
Filler material thickness	: 0.304 to 0.812 mm
Outer ring thickness	: 2.971 to 3.327 mm
Inner ring thickness	: 2.971 to 3.327 mm
Sealing element thickness	: 4.455 ± 0.127 mm

7 TOLERANCE

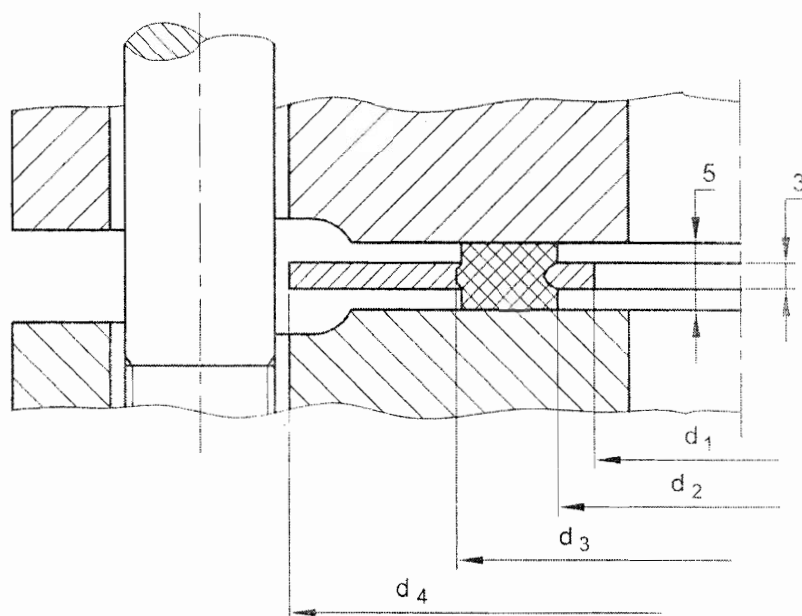
The tolerances on the dimensions of spiral wound gaskets shall be as follows.

7.1 Tolerance on Gasket Outside Diameter

Nominal Pipe Size	Tolerance
15 mm to 200 mm	± 0.8 mm
250 mm to 600 mm	+ 1.5 mm - 0.8
650 mm to 1 500 mm	± 1.5 mm

7.2 Tolerance on Gasket Inside Diameter

Nominal Pipe Size	Tolerance
15 mm to 200 mm	± 0.4 mm
250 mm to 600 mm	± 0.8 mm
650 mm to 850 mm	± 1.2 mm
900 mm to 1 500 mm	± 1.5 mm

**Key**

- d_1 = Inner Diameter of Inner Solid Metal Ring
 d_2 = Inner Diameter of Gasket Element
 d_3 = Outer Diameter of Gasket Element
 d_4 = Outer Diameter of Outer Solid Metal Ring

All dimensions in millimetres.

FIG. 1 DIAMETER OF GASKET

7.3 Tolerance on Outer Ring Outside Diameter

Nominal Pipe Size	Tolerance
15 mm to 600 mm	+0.000 mm -0.762 mm
650 mm to 1 500 mm	+0.000 mm -1.270 mm

7.4 Tolerance on Inner Ring Inside Diameter

Nominal Pipe Size	Tolerance
15 mm to 1 500 mm	± 0.8 mm

8 TEST

8.1 The sample taken from a batch of 12 numbers shall be tested to the rating pressure and temperature. The compression test load for flange gaskets of size 15 mm to 25.4 mm and pressure rating 1.0 MPa to 4.0 MPa shall be calculated using bolt stress of 167 MPa and bolt stress of 210 MPa at the root area for all other sizes and pressure ratings. However, for non-standard gaskets, customer shall have to specify the number and

size of bolts used in the joints. Based on this information, the load during the compression test for these gaskets shall be as agreed to between the manufacturer and the purchaser.

8.2 Procedure for Compression Test

The test shall consist of subjecting the gasket to compression in a hydraulic compression machine of suitable capacity to cover the various standard flange sizes measuring thickness of the gasket while the gasket is under test load.

The gasket shall be tested between steel test plates, the surfaces of which have smooth finish maintained with a circular lay (concentric or phonographic) having a roughness not exceeding 12.5 micron. The test plate shall be centrally located in the ball and socket head of the machine. Four dial indicators having a minimum scale of deviation of 0.02 mm located at 90° apart mounted on the upper compression plate are to be employed for measuring the thickness of the gasket. These dial indicators are also to be used for indicating the uncompressed thickness of the gasket.

Table 3 Gasket Dimensions Up to 600 mm
(Clause 6.1)

All dimensions in millimetres.

Sl No.	Nominal Pipe Size DN	d_1			d_2					d_3	d_4						
		1 MPa	6 MPa	16.6 MPa	1 MPa	2 MPa 4 MPa	6 MPa	10 MPa	16.6 MPa	For all pressure	1 MPa	2 MPa	2.6 MPa	4 MPa	6 MPa	10 MPa	16.6 MPa
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
i)	15	14.2	14.2	14.2	19.1	19.1	19.1	19.1	19.1	31.8	47.8	54.1	54.1	54.1	63.5	63.5	69.9
	20	20.5	20.5	20.5	25.4	25.4	25.4	25.4	25.4	39.6	57.2	66.8	66.8	66.8	69.9	69.9	76.2
	25	26.9	26.9	26.9	31.8	31.8	31.8	31.8	31.8	47.8	66.8	73.2	73.2	73.5	79.5	79.5	85.9
ii)	32	38.1	33.3	33.4	47.8	47.8	39.6	39.6	39.6	60.5	76.2	82.6	82.6	82.6	88.9	88.9	104.9
	40	44.5	41.4	41.4	54.1	54.1	47.8	47.8	47.8	69.9	85.9	95.3	95.3	95.3	98.6	98.6	117.6
	50	55.4	52.3	52.3	69.9	69.9	58.7	58.7	58.7	85.9	104.9	111.3	111.3	111.3	143.0	143.0	145.0
iii)	65	66.8	63.5	63.5	82.6	82.6	69.9	69.9	69.9	98.6	124.0	130.3	130.3	130.3	165.1	165.1	168.4
	80	81	81.8	81	101.6	101.6	95.3	92.2	92.2	120.7	136.7	149.4	149.4	149.4	168.4	174.8	196.9
	100	106.4	106.4	106.4	127.0	120.7	120.7	117.6	117.6	149.4	174.8	181.1	177.8	193.8	206.5	209.6	235.0
iv)	125	131.8	131.8	131.8	155.7	147.6	147.6	143	143	177.8	196.9	215.9	212.9	241.3	247.7	254.0	279.4
	150	157.2	157.2	157.2	132.6	174.8	174.8	171.5	171.5	209.6	222.3	251.0	247.7	266.7	289.1	282.7	317.5
	200	206.5	206.5	206.5	233.4	225.6	225.6	215.9	215.9	263.7	279.4	308.1	304.8	320.8	358.9	352.6	387.4
v)	250	257.8	257.8	257.8	287.3	274.6	274.6	270.0	270	317.5	339.9	362.0	358.9	400.1	435.1	435.1	476.3
	300	306.3	306.3	306.3	339.9	327.2	327.2	323.9	323.9	374.7	409.7	422.4	419.1	457.2	498.6	520.7	549.4
	350	336.6	336.6	—	371.6	362.0	362	362.0	—	406.4	450.9	485.9	482.6	492.3	520.7	577.9	—
vi)	400	384.3	384.3	—	422.4	412.8	412.8	412.8	—	463.6	514.4	539.8	536.7	565.2	574.8	641.4	—
	450	431.8	431.8	—	474.7	469.9	463.6	463.6	—	527.1	549.4	596.9	593.9	612.9	638.3	704.9	—
	500	481.8	481.8	—	525.5	520.7	514.4	514.4	—	577.9	606.5	654.1	647.7	682.8	698.5	755.7	—
vii)	600	577.9	577.9	—	629.7	628.6	616.0	616	—	685.8	717.6	774.7	768.4	790.7	838.2	901.7	—

Table 4 Gasket Dimensions 650 mm and Above
(Clause 6.1)

All dimensions in millimetres.

Sl No.	Nominal Pipe Size DN	d_1					d_2					d_3					d_4				
		1 MPa	2 MPa	2.6 MPa	4 MPa	6 MPa	1 MPa	2 MPa	2.6 MPa	4 MPa	6 MPa	1 MPa	2 MPa	2.6 MPa	4 MPa	6 MPa	1 MPa	2 MPa	2.6 MPa	4 MPa	6 MPa
i)	650	660.4	673.1	673.1	673.1	673.1	673.1	685.8	685.8	685.8	685.8	704.9	736.6	736.8	736.6	736.6	774.7	835.2	831.9	866.9	882.7
	700	711.2	723.9	723.9	723.9	723.9	723.9	738.6	736.8	736.8	736.8	755.7	787.4	787.4	787.4	787.4	831.9	898.7	892.3	914.4	946.2
	750	755.7	774.8	774.8	774.8	774.8	774.7	793.8	793.8	793.8	793.8	806.5	844.6	844.6	844.6	844.6	882.7	952.5	946.2	971.6	1 009.7
ii)	800	806.5	831.9	831.9	839.9	831.9	825.5	850.9	850.9	850.9	850.9	860.6	901.7	901.7	901.7	901.7	939.8	1 006.6	1 003.3	1 022.4	1 073.2
	850	857.3	882.7	882.7	882.7	882.7	876.3	901.7	901.7	901.7	901.7	911.4	952.5	952.5	952.5	952.5	990.6	1 057.4	1 054.1	1 073.2	1 136.7
	900	908.1	939.9	939.9	939.9	939.9	927.1	958.9	958.9	958.9	958.9	968.5	1 009.7	1 009.7	1 009.7	1 009.7	1 047.8	1 117.6	1 117.8	1 130.3	1 200.2
iii)	950	958.9	958.9	952.6	971.6	1 016.1	977.9	977.9	971.8	990.6	1 035.1	1 019.3	1 018.0	1 022.4	1 041.4	1 085.8	1 111.3	1 054.1	1 073.2	1 104.9	1 200.2
	1 000	1 009.7	1 003.4	1 006.7	1 028.8	1 079.6	1 028.7	1 022.4	1 025.7	1 047.8	1 098.6	1 070.1	1 070.1	1 076.5	1 098.6	1 149.4	1 162.1	1 114.6	1 127.3	1 155.7	1 251.0
	1 050	1 060.5	1 054.2	1 057.5	1 085.9	1 130.4	1 079.5	1 073.2	1 076.5	1 104.9	1 149.4	1 124.0	1 120.9	1 127.3	1 155.7	1 200.2	1 219.2	1 165.4	1 178.1	1 219.2	1 301.8
iv)	1 100	1 111.3	1 111.3	1 111.3	1 143.5	1 187.5	1 130.3	1 130.3	1 130.3	1 162.5	1 206.5	1 178.1	1 181.1	1 181.1	1 212.9	1 257.3	1 276.4	1 219.2	1 231.9	1 270.0	1 368.6
	1 150	1 162.1	1 177.1	1 174.8	1 193.9	1 251.0	1 181.1	1 178.1	1 193.8	1 212.9	1 270.0	1 228.9	1 228.9	1 244.6	1 263.7	1 320.8	1 327.2	1 273.3	1 289.1	1 327.2	1 435.1
	1 200	1 212.9	1 216.2	1 225.6	1 251.0	1 301.8	1 231.9	1 235.2	1 244.6	1 270.0	1 320.8	1 279.7	1 286.0	1 295.4	1 320.8	1 371.6	1 384.3	1 324.1	1 346.2	1 390.7	1 485.9
v)	1 250	1 251.0	1 263.7	1 263.7	1 289.1	—	1 282.7	1 295.4	1 295.4	1 320.8	—	1 333.5	1 346.2	1 346.2	1 371.6	—	1 435.1	1 378.1	1 403.4	1 447.8	—
	1 300	1 301.8	1 314.5	1 314.5	1 339.1	—	1 333.5	1 346.2	1 346.2	1 371.8	—	1 384.3	1 397.0	1 397.0	1 422.4	—	1 492.3	1 428.8	1 454.2	1 498.6	—
	1 350	1 352.6	1 371.7	1 371.7	1 397.1	—	1 384.3	1 403.4	1 403.4	1 428.8	—	1 435.1	1 454.2	1 454.2	1 479.6	—	1 549.4	1 492.3	1 517.7	1 555.8	—
vi)	1 400	1 403.4	1 422.5	1 422.5	1 511.3	—	1 435.1	1 454.2	1 454.2	1 479.6	—	1 485.9	1 505.0	1 505.0	1 530.4	—	1 808.6	1 543.1	1 568.5	1 612.9	—
	1 450	1 454.2	1 479.6	1 473.3	1 505.0	—	1 485.9	1 511.3	1 505.0	1 536.7	—	1 536.7	1 562.1	1 555.8	1 587.5	—	1 663.7	1 593.8	1 619.3	1 663.7	—
	1 500	1 505.0	1 530.4	1 536.8	1 562.2	—	1 536.7	1 562.1	1 568.5	1 593.9	—	1 587.5	1 612.9	1 619.3	1 644.7	—	1 714.5	1 644.7	1 682.8	1 733.6	—

During testing, increments of the load shall be applied until the load corresponding to the test load calculated is reached. The maximum rate of loading shall be about 900 kg/s. The specified load shall be maintained only for sufficient time (5 s or 10 s) to obtain the dial indicator readings. The average of four dial indicator reading shall be taken as the compressed thickness of the gasket.

After completion of the test, the load shall be released but the upper compression plate shall be left in contact with the gasket for approximately 10 s and the dial indicator reading shall be taken to determine the recovery of the gasket.

The type of the test failures based on which the gaskets shall be rejected are:

- Gasket buckling at the inner periphery to the extent that metal plies are separated; and
- Welding both at outside and inside has failed.

The initial thickness and compressed thickness shall be as given below:

Initial Thickness	Compressed Thickness as Specified Load	Compression Range	Recovery
mm (1)	mm (2)	mm (3)	mm (4)
3.125 ± 0.125	2.36 ± 0.125	0.64 - 0.89	0.125
4.5 ± 0.125	3.35 ± 0.125	1.03 - 1.28	0.25

8.3 If one gasket fails in a test as outlined in 8.2, one more gasket shall be subjected to a similar test. If that also fails the whole batch of 12 numbers shall be rejected.

9 INSPECTION

The purchaser or his representative shall have free access at all reasonable times to those parts of the manufacturer's works actually engaged upon his contract and shall be at liberty to inspect at any stage of manufacture the materials covered by such contract. The purchaser shall be at liberty to reject any material which does not comply with the requirements of this standard.

10 MARKING

10.1 Identification Marking

Each spiral wound gaskets shall be permanent and legibly stamped on outer ring of gasket with symbols approximately 3 mm high with the following

information:

- Nominal flange bore;
- Nominal pressure rating;
- Outer ring and inner ring metal (no marking required for CS ring);
- Manufacturer's name or trade-mark or code;
- Abbreviated name and colour code to identify the winding metal and filler material; and
- Any other information, if required by the customer.

10.2 BIS Certification Marking

The spiral wound gaskets may also be marked with the Standard Mark.

10.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which a license for the use of the Standard Mark may be granted to the manufacturers or producers may be obtained from the Bureau of Indian Standards.

11 PACKING AND HANDLING

11.1 The gaskets shall be enclosed in dust free and moisture resistant wrappings and packed in the wooden/other sufficiently strong box in flat and horizontal position.

11.2 The identification marking shall be given on each box about the details of the gasket contained in it.

11.3 The spiral wound gasket shall be stored in dust and moisture free environment.

12 INFORMATION TO BE SUPPLIED BY THE PURCHASER

It is recommended that the following information to be supplied by the purchaser in the enquiry or order. If the purchaser requires fittings which deviate from this standard such deviating requirements should be stated in the purchase order:

- Nominal pipe size and nominal pressure rating;
- Outer ring metal and inner ring metal (if required);
- Material required for metallic winding;
- Operating pressure, temperature and fluid;
- Material required for filler;
- Flange particulars; and
- Any other special requirement.

ANNEX A*(Foreword)***COMMITTEE COMPOSITION****Gasket and Packing Sectional Committee, MED 30**

<i>Organization</i>	<i>Representative(s)</i>
Indian Institute of Technology, Kharagpur	SHRI AJIT K. BANTHIA (<i>Chairman</i>)
Banco Products (India) Ltd, Vadodara	SHRI V. K. GUPTA SHRI S. SELVAKUMAR (<i>Alternate</i>)
Bharat Bijlee Ltd, Mumbai	SHRI R. S. MURALEEDHARAN SHRI V. D. DEODHAR (<i>Alternate</i>)
Bharat Corrub Industries, Vadodara	SHRI B. M. TOLIA SHRI S. R. DESAI (<i>Alternate</i>)
Bharat Heavy Electricals Ltd, Trichurapalli	SHRI M. RAJAKUMAR SHRI P. LONGANATHAN (<i>Alternate</i>)
Bharat Petroleum Corporation Ltd, Noida	SHRI S. MANIVANNAN SHRI UMESH GAUTAM (<i>Alternate</i>)
Crompton Greaves Ltd, Mumbai	SHRI P. S. RAMACHANDRAN
Department of Industrial Policy & Promotion, New Delhi	SHRI SHAISH KUMAR SHRI M. Z. KHAN (<i>Alternate</i>)
Fenner (India) Ltd, Madurai	SHRI T. N. KRISHNAN
Ferolite Jointings Ltd, Ghaziabad	SHRI AKSHAY SHARMA SHRI F. C. SHARMA (<i>Alternate</i>)
GAIL (India) Ltd, New Delhi	SHRI M. I. HAQUE SHRI ANUP S. S. KONGARI (<i>Alternate</i>)
Hindustan Petroleum Corporation Ltd, Visakhapatnam	SHRI Y. SRIRAMULU SHRI S. CHAKRADHAR (<i>Alternate</i>)
IGP Engineers Pvt Ltd, Chennai	SHRI G. GANESAN SHRI A. V. PARTHASARTHY (<i>Alternate</i>)
Kirloskar Oil Engines Ltd, Pune	SHRI M. N. KUMAR SHRI D. S. SUBEKAR (<i>Alternate</i>)
NTPC Limited, Noida	SHRI U. K. MUKHOPADHYAY SHRI S. CHAKRABORTY (<i>Alternate</i>)
Nu-Cork Products Pvt Ltd, Gurgaon	SHRI S. K. DATTA
Ordnance Factory Board, Jabalpur	SHRI RAJNISH LODWAL SHRI M. K. MISHRA (<i>Alternate</i>)
Research Designs and Standards Organization, Lucknow	SHRI A. K. MANDAL SHRI I. S. DAS (<i>Alternate</i>)
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This Indian Standard has been developed from Doc No.: MED 30 (0972).

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